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09/910,073	07/23/2001	Hans Martin Hertz	003300-805	2540

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Benton S. Duffett, Jr.
BURNS, DOANE, SWECKER & MATHIS, L.L.P.
P.O. Box 1404
Alexandria, VA 22313-1404

EXAMINER

YUN, JURIE

ART UNIT

PAPER NUMBER

2882

DATE MAILED: 07/14/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/910,073

Applicant(s)

HERTZ ET AL.

Examiner

Jurie Yun

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 10 October 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-44 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-44 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 4.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

Specification

1. Claim 28 is objected to because of the following informalities: in line 1, "ot" should be "or". Appropriate correction is required.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1, 6, 7, 10, 13-24, 26, 28, 33, 34, and 38-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Smither et al. (USPN 4,953,191) and further in view of Hertz et al. (USPN 6,002,744).

4. With respect to claim 1, Smither et al. disclose a method for generating X-ray or EUV radiation comprising the steps of: (i) forming a target (14) by urging a liquid substance (16) under pressure through an outlet opening (22), the target propagating through an area of interaction (20), and (ii) directing at least one electron beam (18) onto the target (14) in the area of interaction (20) such that the electron beam (18) interacts with the target to generate X-ray or EUV radiation.

Smither et al. do not disclose the target is a target jet formed by urging a liquid substance under pressure through an outlet opening.

Hertz et al. disclose forming a target jet (17) by urging a liquid substance (7) under pressure through an outlet opening (10), the target jet propagating through an

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area of interaction (11). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the Smither et al. invention and have the liquid target form a target jet by urging the liquid substance under pressure through an outlet opening, as taught by Hertz et al. As disclosed by Hertz et al. (column 2, lines 52-67), use of a target jet has many benefits such as, for example, a great reduction of debris, a possibility of long-term operation without interruption by providing new target material continuously through the jet of liquid, etc.

5. With respect to claims 26 and 43, Smither et al. disclose a method for generating hard X-ray radiation comprising the steps of: (i) forming a target (14) by urging a liquid substance (16) under pressure through an outlet opening (22), the target propagating through an area of interaction (20), (ii) directing at least one electron beam (18) onto the target (14) in the area of interaction (20) such that the electron beam (18) interacts with the target to generate X-ray or EUV radiation, and (iii) controlling the electron beam to interact with the target at an intensity such that Bremsstrahlung and characteristic line emission is generated in the hard X-ray region, essentially without heating the target to a plasma-forming temperature, wherein the electron beam is generated by means of an acceleration voltage from about 5 kV to about 500 kV and an average beam current from about 10 mA to about 1000 mA.

Smither et al. do not disclose the target is a target jet formed by urging a liquid substance under pressure through an outlet opening.

Hertz et al. disclose forming a target jet (17) by urging a liquid substance (7) under pressure through an outlet opening (10), the target jet propagating through an

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area of interaction (11). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the Smither et al. invention and have the liquid target form a target jet by urging the liquid substance under pressure through an outlet opening, as taught by Hertz et al. As disclosed by Hertz et al. (column 2, lines 52-67), use of a target jet has many benefits such as, for example, a great reduction of debris, a possibility of long-term operation without interruption by providing new target material continuously through the jet of liquid, etc.

6. With respect to claim 28, Smither et al. disclose an apparatus for generating X-ray or EUV radiation, comprising a target generator (Fig. 1) arranged to form a target (14) by urging a liquid substance (16) through an outlet opening (22), the target propagating towards an area of interaction (20), and an electron source (12) for providing at least one electron beam (18) and directing the at least one electron beam onto the target in the area of interaction, said radiation being generated by the electron beam interacting with the target.

Smither et al. do not disclose the target generator is arranged to form a target jet by urging a liquid substance through an outlet opening.

Hertz et al. disclose the target generator is arranged to form a target jet (17) by urging a liquid substance (7) through an outlet opening (10). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the Smither et al. invention and have the target generator arranged to form a target jet by urging the liquid substance through an outlet opening, as taught by Hertz et al. As disclosed by Hertz et al. (column 2, lines 52-67), use of a target jet has many benefits

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such as, for example, a great reduction of debris, a possibility of long-term operation without interruption by providing new target material continuously through the jet of liquid, etc.

7. With respect to claims 6 and 33, Smither et al. do not disclose the electron beam interacts with the jet at a distance from about 0.5 mm to about 10 mm from the outlet opening. Hertz et al. disclose the distance from the nozzle to the drop-formation point is in the order of a millimeter (column 5, lines 3-5). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the Smither et al. invention and disclose the electron beam interacts with the jet at a distance from about 0.5 mm to about 10 mm from the outlet opening. Hertz et al. disclose (column 5, lines 3-8) that the distance should be sufficiently long so that the plasma does not damage the nozzle. Smither et al. disclose concern about heat generated by the electron beam (column 2, lines 60-65). Thus, this modification would be an obvious benefit.

8. With respect to claims 7 and 34, Smither et al. and Hertz et al. do not disclose the step of: (iii) controlling the electron beam to interact with the jet at an intensity such that Bremsstrahlung and characteristic line emission is generated in the hard X-ray region, essentially without heating the jet to a plasma-forming temperature. However, this is inherent in any system which uses an electron beam interacting with a target to produce hard X-rays.

9. With respect to claim 10, Smither et al. disclose the target jet is in a liquid state (16) in the area of interaction (20).

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10. With respect to claim 13, Smither et al. disclose the electron beam (18) interacts with a spatially continuous portion of the target jet (16) in the area of interaction (20).

11. With respect to claims 14 and 38, Smither et al. disclose the electron beam (18) is focused on the target jet (16) to essentially match a transverse dimension of the electron beam to a transverse dimension of the jet (column 4, lines 18-22).

12. With respect to claims 15 and 39, Smither et al. do not disclose the target jet is formed with a diameter from about 1 μm to about 10,000 μm . Hertz et al. disclose the target jet is formed with a diameter of about 10-100 μm (column 3, line 12). It would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify the Smither et al. invention and disclose the target jet is formed with a diameter from about 1 μm to about 10,000 μm . Hertz et al. disclose (column 3, lines 14-17), "The small dimensions contribute to effective utilization of the target material, which, among other things, results in a drastic reduction of debris."

13. With respect to claims 16 and 40, Smither et al. and Hertz et al. do not disclose the electron beam is generated by means of an acceleration voltage from about 5 kV to about 500 kV and an average beam current from about 10 mA to about 1000 mA. However, one of ordinary skill in the art would define these parameters to produce an electron beam current strong enough to produce X-rays useful for its intended use.

14. With respect to claims 17 and 41, Smither et al. do not disclose at least one pulsed electron beam is directed onto the target jet. Hertz et al. disclose at least one pulsed laser beam is directed onto the target jet (column 3, lines 24-25). It would have been obvious to one of ordinary skill in the art at the time the invention was made to

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modify the Smither et al. invention and disclose at least one pulsed electron beam is directed onto the target jet. As taught by Hertz et al., using a pulsed source and microscopic liquid jet would result in radiation useful for lithography of structures below 100 nm (column 3, lines 18-30).

15. With respect to claims 18 and 42, Smither et al. disclose at least one continuous electron beam (18) is directed onto the target jet (16).

16. With respect to claim 19, Smither et al. disclose the step of performing a medical diagnosis with the X-ray or EUV radiation (column 1, lines 12-22).

17. With respect to claim 20, Smither et al. disclose the step of performing non-destructive analysis with the X-ray or EUV radiation (column 1, lines 12-22).

18. With respect to claims 21-23, Smither et al. do not disclose the step of performing EUV projection lithography with the EUV radiation, or the step of performing crystal analysis with the X-ray or EUV radiation, or the step of performing microscopy with the X-ray or EUV radiation. Hertz et al. disclose the step of performing EUV projection lithography with the EUV radiation (claim 13), and the step of performing crystal analysis with the X-ray or EUV radiation (column 6, line 9), and the step of performing microscopy with the X-ray or EUV radiation (claim 11). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the Smither et al. invention and disclose these uses, as taught by Hertz et al. This would provide for a multiple purpose radiation system.

19. With respect to claim 24, Smither et al. disclose the step of performing X-ray diffraction with the X-ray radiation (column 1, lines 12-22).

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20. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Smither et al. (USPN 4,953,191) in view of Hertz et al. (USPN 6,002,744) as applied to claims 1 and 24 above, and further in view of Atac et al. (USPN 5,978,444).

21. With respect to claim 25, Smither et al. and Hertz et al. do not disclose the X-ray diffraction is performed for the purpose of protein structure determination. Atac et al. disclose this (Abstract). It would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify the Smither et al. invention and disclose the X-ray diffraction is performed for the purpose of protein structure determination. The X-ray diffraction could be performed for different purposes, such as protein structure determination, if so desired. And, this is not novel, as exemplified by Atac et al.

22. Claims 8 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Smither et al. (USPN 4,953,191) in view of Hertz et al. (USPN 6,002,744) as applied to claims 1 and 28 above, and further in view of Noda et al. (USPN 4,723,262).

23. With respect to claims 8 and 35, Smither et al. and Hertz et al. do not disclose the step of: (iii) controlling the electron beam to interact with the jet at an intensity such that the jet is heated to a plasma-forming temperature, such that soft X-ray radiation or EUV radiation is generated. Noda et al. disclose producing soft X-ray radiation or EUV by controlling the electron beam to interact with the liquid target at an intensity such that the target is heated to a plasma-forming temperature (column 6, lines 25-33). It would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify the Smither et al. invention and disclose the step of (iii) controlling the

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electron beam to interact with the jet at an intensity such that the jet is heated to a plasma-forming temperature, such that soft X-ray radiation or EUV radiation is generated. Modifying the Smither et al. invention to be able to produce both hard X-rays and soft X-rays would result in a dual energy X-ray source that could be used for a more wide range of applications.

24. Claims 2-5, 9, 11, 12, 29-32, 36, and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Smither et al. (USPN 4,953,191) in view of Hertz et al. (USPN 6,002,744) as applied to claims 1 and 28 above, and further in view of Kondo et al. (USPN 6,324,255 B1).

25. With respect to claims 2, 3, 29, and 30, Smither et al. and Hertz et al. do not disclose the substance comprises a metal heated to a liquid state. Kondo et al. disclose the use of metal heated to a liquid state to use for targets (column 23, lines 39-43). It would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify the Smither et al. invention and disclose the substance comprises a metal heated to a liquid state, as taught by Kondo et al. As evidenced by the Kondo et al. laundry list (column 23, lines 31-47) of useful target materials and their different states (gas, liquid, or solid), the use of which type of target to use is a design choice.

26. With respect to claims 4, 5, 31, and 32, Smither et al. and Hertz et al. do not disclose the substance is a noble gas cooled to a liquid state. Kondo et al. disclose the target could be a noble gas cooled to a liquid state (column 23, lines 31-47 & column 13, lines 48-50). It would have been obvious to one of ordinary skill in the art at the time

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the invention was made to further modify the Smither et al. invention and disclose the substance comprises a noble gas cooled to a liquid state, as taught by Kondo et al. As evidenced by the Kondo et al. laundry list (column 23, lines 31-47) of useful target materials and their different states (gas, liquid, or solid), the use of which type of target to use is a design choice.

27. With respect to claims 9 and 36, Smither et al. and Hertz et al. do not disclose the target jet is in a solid state in the area of interaction. Kondo et al. disclose this (column 23, lines 31-47). It would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify the Smither et al. invention and disclose the target jet is in a solid state in the area of interaction, as taught by Kondo et al. As evidenced by the Kondo et al. laundry list (column 23, lines 31-47) of useful target materials and their different states (gas, liquid, or solid), the use of which phase of a target jet to use is a design choice.

28. With respect to claims 11 and 12, Smither et al. and Hertz et al. do not disclose the electron beam interacts with at least one droplet or with a spray of droplets or clusters in the area of interaction. Kondo et al. disclose this (column 13, lines 43-50 & column 19, lines 46-47). It would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify the Smither et al. invention and disclose the electron beam interacts with at least one droplet or with a spray of droplets or clusters in the area of interaction, as taught by Kondo et al. As evidenced by the Kondo et al. laundry list (column 23, lines 31-47) of useful target materials and their

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different states (gas, liquid, or solid), the use of which type of target jet to use is a design choice.

29. With respect to claim 37, Smither et al. disclose the target generator is controllable to provide a spatially continuous portion of the jet (16). Smither et al. and Hertz et al. do not disclose the target generator is controllable to provide at least one droplet, or a spray of droplets or clusters in the area of interaction. Kondo et al. disclose this (column 13, lines 43-50 & column 19, lines 46-47). It would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify the Smither et al. invention and disclose the target generator is controllable to provide at least one droplet, or a spray of droplets or clusters in the area of interaction, as taught by Kondo et al. As evidenced by the Kondo et al. laundry list (column 23, lines 31-47) of useful target materials and their different states (gas, liquid, or solid), the use of which type of target jet to use is a design choice.

30. Claims 27 and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Noda et al. (USPN 4,723,262) and further in view of Hertz et al. (USPN 6,002,744).

31. With respect to claims 27 and 44, Noda et al. disclose (Fig. 1 and column 2, lines 65+) a method for generating soft X-ray or EUV radiation comprising the steps of: (i) forming a target by urging a liquid substance under pressure through an outlet opening, the target propagating through an area of interaction, (ii) directing at least one electron beam onto the target in the area of interaction such that the electron beam interacts with the target to generate X-ray or EUV radiation (column 6, lines 25-33), and (iii) controlling the electron beam to interact with the target at an intensity such that the target is heated

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to a plasma-forming temperature, such that soft X-ray radiation or EUV radiation is generated, wherein the electron beam is generated by means of an acceleration voltage from about 5 kV to about 500 kV and an average beam current from about 10 mA to about 1000 mA.

Noda et al. do not disclose the target is a target jet formed by urging a liquid substance under pressure through an outlet opening.

Hertz et al. disclose forming a target jet (17) by urging a liquid substance (7) under pressure through an outlet opening (10), the target jet propagating through an area of interaction (11). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the Noda et al. invention and have the liquid target form a target jet by urging the liquid substance under pressure through an outlet opening, as taught by Hertz et al. As disclosed by Hertz et al. (column 2, lines 52-67), use of a target jet has many benefits such as, for example, a great reduction of debris, a possibility of long-term operation without interruption by providing new target material continuously through the jet of liquid, etc.

Conclusion

32. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Fiedorowicz et al. (USPN 6,469,310 B1) disclose a radiation source for EUV. Richardson et al. (USPN 5,577,091) disclose water laser plasma X-ray point sources.

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33. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jurie Yun whose telephone number is 703 308-3535.

The examiner can normally be reached on Monday-Friday 8:30-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ed Glick can be reached on 703 308-4858. The fax phone numbers for the organization where this application or proceeding is assigned are 703 308-7722 for regular communications and 703 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703 308-0956.

Jurie Yun
June 20, 2003


EDWARD J. GLICK
Supervisory Patent Examiner
TECHNOLOGY CENTER 2800